

What is claimed is:

1. A semiconductor device manufacturing method comprising the step of:

5 plasmanizing a process gas containing any one of N_2 and N_2O ; and

reforming a surface layer portion of a copper wiring layer to make the surface layer portion into a copper diffusion preventing layer by exposing a surface of the copper wiring layer to the plasmanized process gas.

10 2. A semiconductor device manufacturing method according to claim 1, wherein a hydrocarbon is added to the process gas.

3. A semiconductor device manufacturing method according to claim 2, wherein the hydrocarbon is any of CH_4 and C_2H_2 .

15 4. A semiconductor device manufacturing method comprising the step of:

plasmanizing a process gas containing N_2 and NH_3 ; and

20 reforming a surface layer portion of a copper wiring layer to make the surface layer portion into a copper diffusion preventing layer by exposing a surface of the copper wiring layer to the plasmanized process gas.

25 5. A semiconductor device manufacturing method according to claim 1, further comprising the step of:

exposing the surface of the copper wiring layer to a NH_3 plasma before the surface layer portion of the

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copper wiring layer is reformed.

6. A semiconductor device manufacturing method according to claim 1, further comprising the step of:

5 forming a silicon- containing insulating film on the copper wiring layer after the surface layer portion of the copper wiring layer is reformed.

7. A semiconductor device manufacturing method according to claim 6, further comprising the step of:

10 plasmanizing a process gas containing at least one of NH_3 , N_2 , and N_2O ; and

after forming the silicon-containing insulating film, exposing the silicon-containing insulating film to the plasmanized process gas.

15 8. A semiconductor device manufacturing method according to claim 6, further comprising the step of:

forming an interlayer insulating film on the silicon- containing insulating film;

20 forming a via hole in the silicon-containing insulating film and the interlayer insulating film;

burying a plug connected electrically to the copper wiring layer in the via hole; and

forming an upper wiring connected electrically to the plug on the interlayer insulating film.

25 9. A semiconductor device manufacturing method comprising the steps of:

forming a silicon-containing insulating film on a copper wiring layer;

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plasmanizing a process gas containing at least one of NH_3 , N_2 and N_2O ; and

reforming the silicon-containing insulating film by exposing the silicon-containing insulating film to the plasmanized process gas.

10. A semiconductor device manufacturing method according to claim 9, further comprising the step of:

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10 exposing a surface of the copper wiring layer to a NH_3 plasma before the silicon-containing insulating film is formed.

11. A semiconductor device manufacturing method according to claim 9, further comprising the step of:

15 forming an interlayer insulating film on the silicon-containing insulating film after the silicon containing insulating film is reformed;

forming a via hole in the silicon-containing insulating film and the interlayer insulating film;

burying a plug connected electrically to the copper wiring layer in the via hole; and

20 forming an upper wiring connected electrically to the plug on the interlayer insulating film.

12. A semiconductor device manufacturing method according to claim 8 or claim 11, wherein the interlayer insulating film is any one of an FSG film and a porous SiO_2 film.

13. A semiconductor device manufacturing method according to claim 6 or claim 9, wherein the silicon-

a chemical vapor deposition method using a reaction gas containing SiH_4 and N_2O .

19. A semiconductor device manufacturing method according to claim 18, wherein NH_3 is added to the
5 reaction gas.

20. A semiconductor device manufacturing method according to claim 13, wherein the SiO film is formed by a chemical vapor deposition method using a reaction gas containing organic silane.

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10 21. A semiconductor device manufacturing method according to claim 13, wherein the SiCH film is formed by a chemical vapor deposition method using a reaction gas containing organic silane and hydrocarbon.

15 22. A semiconductor device manufacturing method according to claim 13, wherein the SiCNH film is formed by a chemical vapor deposition method using a reaction gas containing NH_3 , organic silane, and hydrocarbon.

23. A semiconductor device manufacturing method according to claim 20, wherein the organic silane is
20 $\text{TMS}(\text{Si}(\text{CH}_3)_4)$.

24. A semiconductor device manufacturing method according to claim 21, wherein the hydrocarbon is CH_4 or C_2H_2 .

25 25. A semiconductor device manufactured by the semiconductor device manufacturing method set forth in any one of claims 1, 4, and 9.